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A preliminary paper on *Costaria* with description of a new species.¹

DE ALTON SAUNDERS.

WITH PLATE VII.

In the latter part of last July, I found on the shores of Monterey Bay a few imperfect specimens of one of the Laminariaceæ which seemed to me at once to be different from anything described in the literature accessible in the Hopkins Sea Side Laboratory. It was evidently a *Costaria*, but the two described species of *Costaria* have five narrow ribs, while this plant had one broad one.

A few days later I collected the same plant a mile further east near the steamship landing at Monterey. In the course of a week or so two of the Stanford students who were dredging for the zoologist of the Hopkins Laboratory brought me several fragments of the same *Costaria*. These fragments had been brought up by the dredge a half-mile from the shore from a depth of about fifty feet. A systematic search showed that the plant was quite common, at least in one part of the bay, growing in large clusters attached to rocks twenty to thirty feet from the shore, in eight to fifteen feet of water. As one looked at it waving back and forth in eight or ten feet of water he would take it at once to be *Dictyonereis Californicum* Rupr., which is abundant all along the Californian coast.

I obtained a large number of plants, many of which were in fruit. A careful search along the shore of other parts of the bay, and also of the neighboring ocean, has so far failed to reveal any trace of the plant.

I am informed that specimens have been sent to at least one of the leading phycologists of the United States, and he referred it to *Costaria costata* (Turn.) (*C. Turneri* Grev.). The specimens sent must have been very imperfect indeed to give one such an impression as will be seen by comparing *C. costata* (Turn.) with this plant.

GENERAL DESCRIPTION.—The plant is of an olive-green color, and varies in shape from oblong to lanceolate linear.

¹Read before the Botanical Seminar, University of Nebraska, December 22, 1894.

The blade is thin and very brittle, and is covered throughout with peculiar reticulations which diminish in size as they approach the growing point (the union of blade and stipe). The midrib is about twice the thickness of the body of the plant, and is broad and smooth, no reticulations ever crossing it. The reticulations vary much in prominence; in some individuals they are barely visible, while in others they are very prominent. The midrib also varies much in plants of the same or nearly the same size. In some plants evidently mature it is little over $\frac{1}{4}$ in, while in others of about the same size it is often 2 in broad. At the base the plant is either heart-shaped and abruptly contracted, or in smaller specimens lanceolate and gradually contracted into a short thick stipe. From the ends and sides of the stipe innumerable dichotomously branched rootlets are given off which attach the plant very firmly to rocks, etc. Frequently the lower half of the stipe is turned abruptly at right angles to the upper half and the rhizoids are then attached to the lower surface (fig. 2, *R* and *R'*).

HISTOLOGY.—A cross section of the stem reveals three kinds of tissue; the epidermis, hypodermis and medullary layer (fig. 3, *e*, *h*, and *m*). The epidermis consists of a single row of cells oblong in cross-section, 16–20 μ in length, 8 μ broad, the outer wall considerably thickened. In a longitudinal section they are the same shape, showing that they are quadrilateral, the long axis lying in a radial plane (fig. 3, *c*).

The hypodermis is made up of five rows of parenchymatous cells. The outer hypodermal row is made up of very small (8 μ broad) rounded cells. The remainder of the hypodermis is composed of large, irregular, thin walled cells, which increase somewhat in size towards the medullary layer (figs. 3, and *h*, and 4). The chloroplasts are confined mostly to the outer two or three rows of the hypodermis.

The medullary layer presents a very interesting structure. We may distinguish three varieties of cells in it: (*a*) Two or three rows of narrow, elongated, rather thick walled cells, along the sides next to the hypodermis (figs. 3 and 5, *c*). (*b*) Large oval or flask-shaped cells (*Schleimgänge*) some of which seem to have been formed by the union of two cells. Connected with one end of the flask-shaped cells there are long, narrow cells with few or no cross partitions. The tubular cell sometimes ends blindly and sometimes seems to unite with other cells. The

opposite end of the flask-shaped cell is usually closed and not connected with any other cell (fig. 5, *b*). (*c*) In the central part of the medullary layer between the flask-shaped cells there are many oblong, thin-walled cells running at right angles to the direction of growth. Occasionally they are found singly, but more often there are several united, forming a chain which often reaches across the medullary part (fig. 5, *a*). There is no difference in structure between the midrib and the rest of the blade. The greater thickness of the midrib is caused by an increase in the thickness of the medullary layer (fig. 2).

The reproduction of this plant is in no way different from the other species of the Laminariaceæ. Unicellular zoosporangia protected by paraphyses are borne in large irregular patches on every part of the blade. In some luxuriant individuals I have found the patches of zoospores extending upon or even across the midrib. The zoospores are evidently developed from the epidermal cells, for we find in cross-sections of fruiting specimens the outer row of small hypodermal cells just beneath the zoosporangia (comp. figs. 3 and 4, *i*).

A study of the stipe reveals an entirely different structure. It is very tough and rigid, and is composed entirely of cells which are about twice as long as broad, and much smaller in the hypodermal than the medullary region. In fact in many of the sections there seems to be, especially in the hypodermal region, little or no space between the cell walls. The epidermis of the stipe is composed of very irregular thick walled cells, the walls of which are of a brownish color (fig. 6).

In the rootlets, especially towards the apex, the cell walls are much thinner, the cells larger and longer (fig. 7).

NOMENCLATURE.—In looking up the descriptions of the two recognized species of *Costaria* I find that the names of the two have been changed several times without right or reason for so doing. As we are gradually approaching a stable nomenclature, it seems proper that at this time we should restore to these plants the names which rightfully belong to them.

The common species on the Californian coast has been called *Costaria Turneri* Grev. It is not, however, *Costaria Turneri* Grev., but *Costaria Mertensii* J. Ag.²

²Species, genera et ordines Algarum 1: 140. 1848.—Neither should the name be written *Costaria Mertensii* (Mert.) Post & Rupr. as Kjellman has done in Engler & Prantl's Pflanzenfamilien 1²: 257.

The other species, *Costaria Turneri* Grev., was named *Fucus costatus* by Turner in 1819,³ but Greville in 1830 changed it to *Costaria Turneri* Grev.⁴

Under the present rules of nomenclature we must then return to Turner's specific name which results in *Costaria costata* (Turn.).

Since the two species have been somewhat confused and the genus will have to be broadened somewhat to include the new species, the following synopsis may not be amiss.

To some it may seem that the possession of a single broad rib ought to be considered as a generic distinction, but after a careful comparative study of the structure of this plant with *Costaria Mertensii* J. Ag., I prefer to broaden the generic description enough to include this plant.

COSTARIA, Greville. Alg. Brit., Syn. p. xxxix. 1830.

Plant undivided, one to five-ribbed; ribs when more than one, radiating from a simple, plain stipe. Fruit as in *Laminaria*, indefinite brown spots on any part of the plant.

§I. *Plant 5-ribbed.*

COSTARIA MERTENSII, J. Ag. Spec. gen. et ordin. Alg. 1: 140. 1848.

Fucus costatus Mert. Jun. Lim. 4:—. 1829.

Costaria Turneri Post & Rupr. Illust. Alg. 12. pl. 24.

Plant from five inches to a foot broad; stipe expanding from the base into a plain undivided reticulate blade. Rootlets dichotomously branched.

Common on the Californian coast.

Costaria costata (Turn.), nom. nov.

Fucus costatus Turn. Fuci, etc. pl. 226.

Costaria Turneri Grev. Alg. Brit., Syn. p. xxxix.

Plant seldom over two inches broad; lanceolate, two feet long. Rootlets nearly simple.

As far as I can discover, this plant has never been reported for the Californian coast before. The information I have been able to obtain in reference to its distribution is from Agardh (Species, Genera et Ordines Algarum, 139-140). He says of its habitat, "On the Pacific shores of Central America or ? North America." The interrogation mark before North America is explained by a sentence a few lines further on

³Turner, Fuci, etc. 4:—. pl. 226.

⁴Alg. Brit., Synopsis p. xxxix.

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where he says, "In one place in Turner's work, the native country of this plant is said to be Central America, in another place, North America." I have two complete specimens, one in fruit, that I collected a short distance from Pacific Grove, Cal., which are unquestionably this plant.

§ II. *Plant 1-ribbed.*

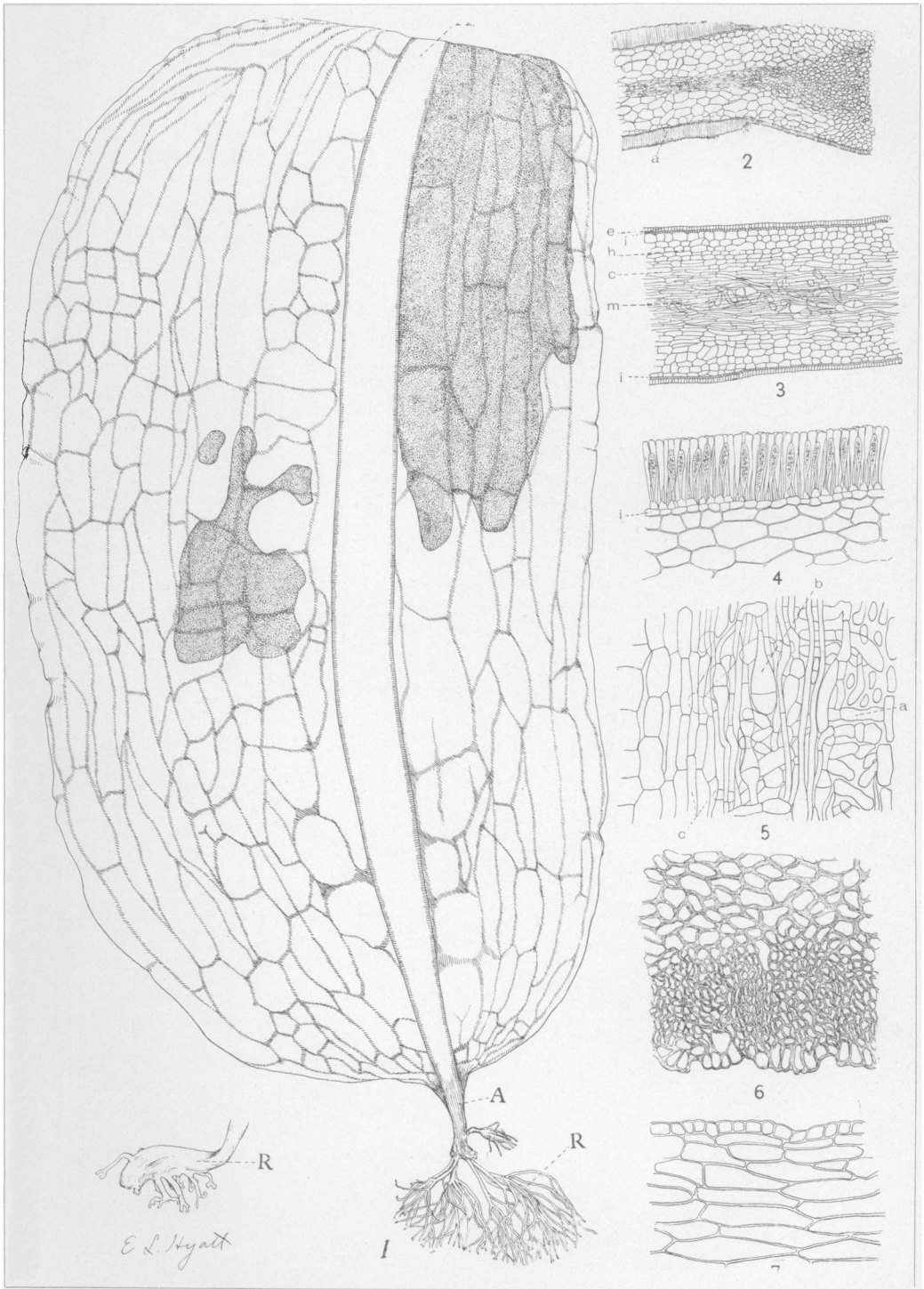
***Costaria reticulata*, n. sp.—PLATE VII.**

Plant thin, olive green, two feet or more in length, two to ten inches broad; stipe short, $\frac{1}{2}$ – $1\frac{1}{2}$ inches in diameter, furnished with numerous dichotomously branched rootlets. Plant furnished with a broad central midrib twice the thickness of the remainder of the blade; midrib one-half to two inches in width; the surface, except the midrib, covered with coarse reticulations which gradually diminish in size towards the union of blade and stipe. Zoosporangial areas, dark brown patches of olive brown spores scattered over the surface of the blade, often covering midrib; sporangia indistinguishable from those of *Costaria Mertensii* J. Ag.—Habitat south shore of Monterey Bay, near Pacific Grove, Cal.

Lincoln, Neb.

EXPLANATION OF PLATE VII.

Fig. 1. *Costaria reticulata*, n. sp. Reduced one-half.—Fig. 2. Transection, showing union of body and midrib, and the zoosporangia. $\times 70$.—Fig. 3. Longissection of midrib. $\times 70$.—Fig. 4. Transection showing zoosporangia. $\times 330$.—Fig. 5. Longissection of midrib, showing *c*, *h*, and *m*, of fig. 3. $\times 330$.—Fig. 6. Transection of stipe. $\times 330$.—Fig. 7. Transection of rootlet near tip.



SAUNDERS on COSTARIA.